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Statistical analyses on the thermal plasma density of the plasmasphere from the Akebono PWS observation

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The plasmasphere is a region of cold and dense plasma surrounding the Earth. The thermal plasma density of the plasmasphere is an important parameter for understanding the dynamics of the radiation belts as well as the inner magnetosphere, because the thermal plasma density controls the wave-dispersion relation, resonance conditions, etc. In this study, we conduct statistical analyses on the variations of the plasmasphere and plasmatrough, using electron density data derived from long-term plasma wave observations by the PWS experiments on board the Akebono satellite. We investigate the solar cycle variations of the thermal plasma density distribution. In deep plasmasphere, the thermal plasma density distributions along the field line do not significantly change during the solar cycle, and their distributions are well modeled as the diffusive equilibrium. On the other hand, the thermal plasma density distributions drastically change during the solar cycle in the outer portion of the plasmasphere. The thermal plasma density distributions are similar to the collisionless model during the solar active periods, while those are similar to the diffusive equilibrium model during the solar quiet periods. We also investigate time variations of the plasmaspheric density distribution during geomagnetic storms driven by CMEs and CIRs with superposed epoch analyses. The zero time corresponds to the minimum of the Dst index. The plasmaspheric density shrinkage depends on the storm amplitudes. The recovery time of the thermal plasma density is significantly different between CME- and CIR-storms. During the recovery phase of CIR-storms, the plamapause does not recover quickly because of prolonged substorm activities during the high-speed steams. The recovery rates of the thermal plasma density depend on the L-shell, which is consistent with the previous studies. We find that the recovery rates of CME-storms are larger than that of CIR-storms.
Keywords: plasmasphere, electron density, akebono satellite, solar-cycle, geomagnetic storm